ZOOGOER

MAY • JUNE 1996

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ZOOGOER

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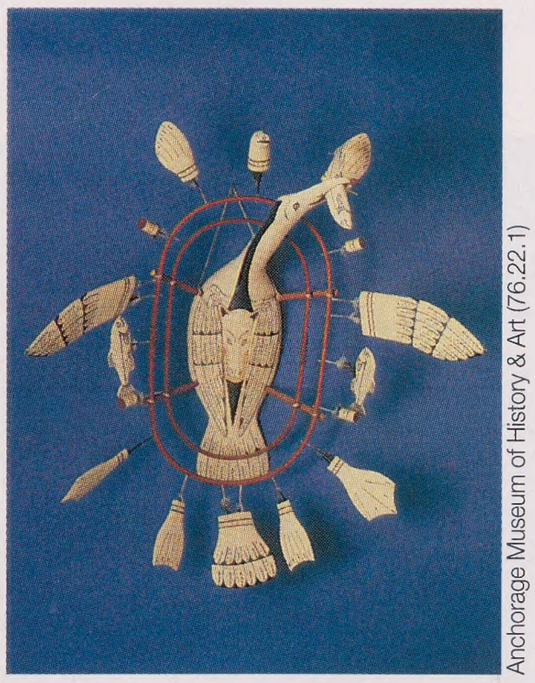
DEPARTMENTS



Anchorage Museum of History & Art (76.22.1)

Alaskan native American mask carver Peter Luke Smith fashioned this loon mask out of wood, feathers, sinew, and ocher and other pigment.

Friends of the National Zoo

is a nonprofit organization of individuals, families, and organizations who are interested in helping to maintain the status of the National Zoological Park as one of the world's great zoos, to foster its use for education, research, and recreation, to increase and improve its facilities and collections, and to advance the welfare of its animals.

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Editor: Susan Lumpkin
Associate Editor: Howard Youth
Intern: Alex Hawes

Contributing Editor: Robin Meadows
Consulting Editor this issue: Robert Hoage
Copy Editor: Jean B. McConville
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The Zoo recently changed the name of the Education Building to the Visitor Center. You may have noticed the change on a recent visit or in this magazine's Notes & News department and wondered why. The reason is simple. Too often Zoo visitors read the word "education" and passed by the building. Young people especially were apt to make a high-spirited show of avoiding "education" at all costs. What these visitors missed, of course, was the chance to get a Zoo map, to browse in the Bookstore, to drop into Zoolab, or to use the restroom or telephone. We believe Visitor Center better suggests what the building offers: amenities as well as education. More to the point, Visitor Center welcomes everybody.

It's interesting that people who find an Education Building uninviting are nonetheless at the Zoo. After all, education is a primary purpose of the Zoo and many people come to the Zoo for the educational opportunities it offers both kids and adults. They read every sign and take time to use the interactives in Think Tank and Reptile Discovery Center. They stop to watch an elephant training demonstration. Perhaps they buy a book to take home so they can learn more about tigers or tarantulas.

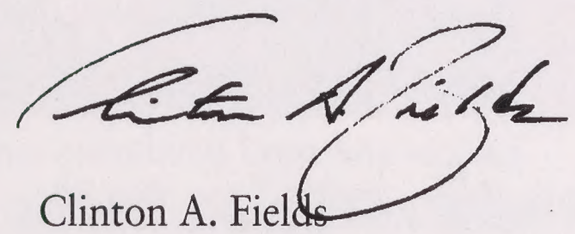
Others come to the Zoo to have fun, to get the kids out of the house, or just to see some exotic animals. Some people may avoid any obviously educational material, but they really can't avoid being educated here. Even the most casual visitors—people who breeze through the Zoo to see a lion here and a bear there—learn a lot, probably a lot more than they think. Simply seeing, hearing, and, in some cases, smelling a wild animal is educational. No picture in a book or image on a television screen conveys how tall a giraffe is or how tiny a pygmy marmoset is the way seeing these animals in the flesh does.

Beyond sharpening visitors' appreciation for familiar wild animals, the Zoo also exposes people to animals they've never heard of. Aside from biologists or amateur naturalists, who except a Zoo visitor would know such creatures as bongos, kori bustards, water dragons, and sea cucumbers even existed? At a very minimum, every Zoo visitor leaves with a better idea of biological diversity, whether he or she knows that phrase or not. And in the best case, some visitors are inspired to want to know more about the strange creatures they've seen for the first time.

Children—many of the same children who would ignore the Education Building—love the Zoo. As they race from exhibit to exhibit, exclaiming in wonder at the sight of an orang utan using a computer, sweating in the humidity of Amazonia, imitating the raucous songs of gibbons, they are absorbing wonderful lessons about the natural world. At the Zoo, children first realize there is a world of wildlife and wilderness beyond the tamed confines of our cities and suburbs.

It is especially for children that we now call the Education Building the Visitor Center. If we can lure them in with restrooms and telephones, maybe once inside they'll venture into the Bookstore or Zoolab and learn a little more. We are committed to educating people about the natural world and we'll do whatever it takes to fulfill that commitment.

Sincerely,

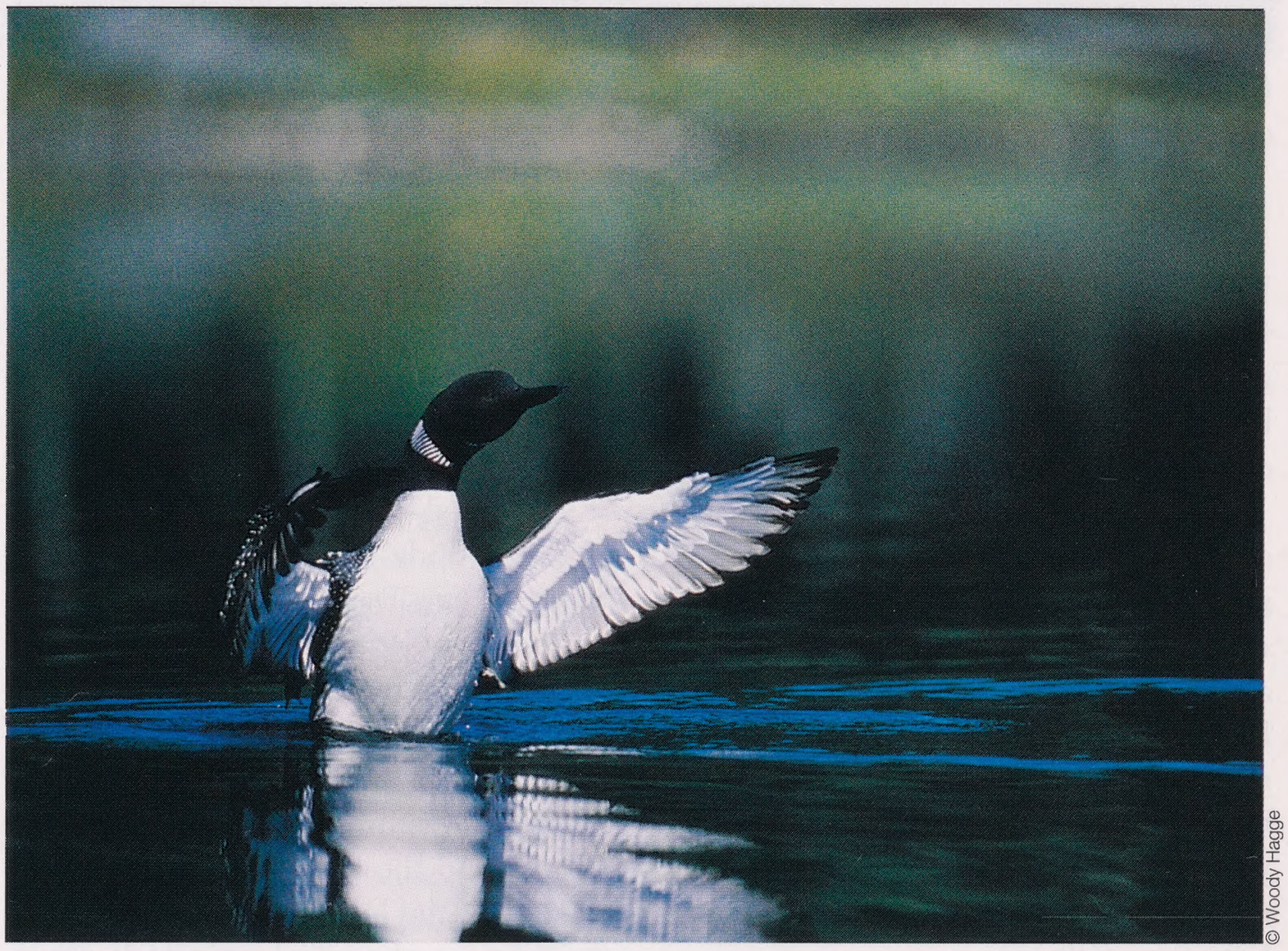


Clinton A. Fields
Executive Director

Testing the Legends of

LOONS

Walter Piper



© Woody Hagge

The most widespread myth about loons is that they mate for life.

I first heard the echo of loons' voices across Lake Temagami, a 91-square-mile watery expanse some 300 miles north of Toronto, where my family had a string of rustic cabins. The loons usually called at night, and in the morning my mother, her eyes bright with excitement, would ask my brother and me, "Did you hear the loons last night? Wasn't it wonderful?" Although he and I were both heavy sleepers, especially during those cool July nights when we lay nestled in flannel sheets and thick wool blankets, we too were often awakened—and enchanted—by the birds' calls.

The loons' resonant laughter and long, mournful wails were sounds that made me, a product of big city suburbs, glad I was safely indoors with the door firmly latched. And yet they were magical sounds that filled me with wonder and respect for loons. During long summer days on the lake, we saw many of these birds, often in pairs, diving, remaining underwater for what seemed an eternity, and then finally surfacing a hundred yards away.

© Woody Hagge

Common loons only breed on northern lakes that provide protected nest sites and plenty of fish and other aquatic creatures to eat.

We seldom succeeded in keeping these wary creatures in sight for more than a few minutes, despite heroic efforts to follow them by canoe. Their skittishness only increased my fascination.

Thirty years have passed since I first saw and heard loons on Temagami, and in many ways I find their behavior more vexing now than ever. I have grown up and devoted my life to the study of animal behavior. I am not sure the loons inspired my career, but it excites me that now I have the training, after years of research with more mundane species, to unlock the mysteries of loon behavior. In a sense, I have come full circle.

I am not alone in my reverence for loons. Residents on lakes throughout the loon's breeding range—which stretches from Alaska to Iceland and includes northerly portions of 14 northern states—have come to adore these creatures because of their ghostly nocturnal calls, stylish black and white plumage, and beady orange eyes. The common loon, the species I watched at Temagami, is the most familiar of the five loon species in its family. It breeds on lakes ranging from a few acres in size to Lake Superior; wherever it can find fish to eat and a protected area in which to nest and raise its one or two young.

The appearance of common loons on countless stamps, coins, billboards, mailboxes, and license plates attests to the popularity of the species. Loon researchers too have come to venerate their study animal—to the point where a considerable body of legend has grown up around them. The most widespread myth among loon enthusiasts is that the birds mate for life; that is, each bird has only one mate during its lifetime and refrains from breeding after its mate dies. A related myth is that each loon returns, year after year, to the same breeding lake. In examining the loons' mating system and the behavior of marked individuals, I was in a position to put such legends to the test.

The first inkling that I might finally learn about the mysterious aquatic creatures that haunted my youth came during the summer of 1992, when I met David Evers. Beginning in 1989, Evers, a wildlife biologist working with the Whitefish Point Bird Observatory in northern Michigan, had begun refining the onerous and previously ineffective technique used to capture adult loons. By the time I met him, he had become the world's expert. As one might imagine, safely catching and restraining a powerful 10- to 12-pound aquatic creature with a daggerlike bill is

Single loons often intrude on a couple's territory and are usually chased away.

no small task. But Evers had found that, armed with a small motorboat, a spotlight, tapes of loon calls, and a net used for landing large sportfish, four courageous souls working at night could accomplish this feat with great success.

Evers' breakthrough had allowed him to place distinctive combinations of colored leg bands on 536 adult loons and 267 chicks since 1989, mostly in Wisconsin, Michigan, and Minnesota. By censusing the birds in subsequent years, Evers then began to determine the rates at which they returned to their territories and to learn about the life histories of individual loons. His main interest was loon conservation, especially the threat posed by exposure of loons to methylmercury, a neurotoxin and environmental contaminant that accumulates in the small fish eaten by loons and occurs in high enough levels in loon tissues to pose a potential threat to survival and reproduction.

What intrigued me, as a behavioral ecologist, were the frequent instances that Evers observed in which mated pairs appeared to share their territories with third, unbanded individuals that were often males. If mated loons commonly spent time with other males, I reasoned, what was to stop females from mating with them? Many songbirds engage in so-called extrapair matings (see sidebar, page 10). Why should loons be any different?

Actually, I expected loons to be different. In most birds, females can raise several young to independence without male assistance. This offers males the opportunity to increase their reproductive success by copulating with females other than their mates. For their part, females might participate in such copulations as insurance against their own mates being sterile or to improve the genetic quality of their offspring. Loons, however, depend almost entirely upon alert and rapidly swimming prey: fish and crayfish. Moreover, chicks eat prodigious amounts and are unable to feed themselves for three months. These constraints seem to force male loons to assist females in caring for the one or two chicks that hatch. The enormous expenditure of time and energy males put into raising chicks raises the stakes in the paternity game. We would expect a male loon to try to ensure that he is the genetic father of the young he raises, perhaps by guarding his mate during the period in which she is fertile.

The observation of frequent association between third loons and breeding pairs had cast doubt upon my expectation of genetic monogamy in loons. But the data I collected dispelled that doubt. I learned

However, knock-down, drag-out battles do occur, and occasionally an intruder wins the skirmish and usurps the resident bird's territory and mate.

that loon pairs do remain close together. In fact, they spend 82 percent of their time within 20 yards of each other during the female's fertile period, leaving little opportunity for extrapair copulations. Moreover, DNA fingerprinting showed that all 58 chicks from 47 loon families were the genetic offspring of the pair that reared them. Thus, among the hundred or so birds in which genetic analysis of parentage has been carried out, loons fall into the handful—including such species as the black vulture, peregrine falcon, Old World willow warbler, and Wilson's storm petrel—wherein males always rear their own offspring.

If the extra loons in breeding territories that David Evers had observed were not males seeking extrapair copulations, then who were they and what were they after? Previous observers had regarded loon intruders as rare visitors of little consequence to the breeding biology of pairs. But I found intrusions to be frequent—occurring two to six times a day in most territories throughout the three-month-long breeding season. Most pairs have to engage in constant confrontations—and the occasional knock-down, drag-out battle—with intruders. I had two remaining hypotheses about the intruders: First, they might simply be looking for food; call this the foraging hypothesis. Second, they might have been trying to take over territories from the resident pair; the takeover hypothesis.

I tested these two hypotheses in 1994 and 1995. It was easy to reject the foraging hypothesis. An intruding loon rarely forages; it spends most of its time approaching, interacting with, or fleeing from the resident pair. Only the takeover hypothesis remained, and, on the face of it, it appeared plausible.

Good breeding territories—those in which chicks are produced almost every year—are a scarce commodity in northern Wisconsin owing to a high rate of egg predation. Some territories are inhabited by pairs or loners of either sex that never attempt to nest. Other territories rarely produce chicks, despite two to three annual attempts by a resident pair. A third class of territories—those with few predators or those with islands that provide loons with nesting sites that predators cannot reach—consistently produce chicks. From a loon's point of view, northern Wisconsin is a swath of poor territories dotted with a few good ones. For this reason, most loons should be looking to move to a better territory. Vacancies do arise through the deaths of residents, but the fastest means of obtaining a good breed-


© Woody Hagge

After their eggs have hatched, adult loons often carry their fluffy young on their backs.

ing slot is simply to kick someone else out of theirs!

The possibility that loons might usurp each others' territories—and each others' mates—horrifies those who embrace the widespread legend that loons remain on a single territory and mate for life. It is with a heavy heart, but with scientific certainty, that I report that loons do kick each other off of territories—and quite frequently. In fact, of the 36 marked territorial residents I observed from 1993 to 1995, six lost their territorial positions during the breeding season. At least five of these were kicked off their territories by unmarked intruders, three females and two males. Clearly, loons often lose their breeding positions to territorial intruders, and residents of both sexes are vulnerable.

Most damaging to loon legend, however, is the indifference with which each loon seems to view the territorial battles of its mate. The vast majority of battles that occur in breeding territories—which can include vicious pecking, beating with wings, and lengthy chases across the water—occur between single intruders and the pair member of the same sex. Moreover, when a loon is driven off its territory, it departs alone, leaving his or her conqueror and erstwhile mate as the new breeding pair in possession of the territory. Any eggs or chicks produced by the original two birds are lost, although the remaining member of the original pair often attempts to renest with its new mate. Thus, the much-vaunted pair bond of loons does not outlast each pair member's ability to defend its breeding position from intruders of its own sex.

I don't mean to suggest that all breeding loons must fight constantly to maintain their breeding status. Violent fights are, in fact, quite rare. But breeding pairs—especially those with good territories—encounter anywhere from dozens to hundreds of intrusions each year. In most cases, an intruder spends five to 15 minutes engaging in a series of stereotyped interactions with the pair that includes approaching, circling, and head bowing and then it flies away, perhaps to intrude elsewhere. Eventually an intruder will arrive that does not leave quickly, and this leads to an escalated battle that might cost the embattled resident its territory and its mate. We are currently trying to understand the factors that lead to such escalated contests.

What is the fate of breeders that have been driven off of their territories? In the five observed cases, these birds simply moved "next door," taking up residence in the nearest unoccupied lake. One fe-

Loons appear on stamps, coins, and bills, and their haunting calls touch many people who live or vacation near northern lakes in summer.

male attempted unsuccessfully to breed at the new lake the year after losing her territory. A second female became a nonbreeder but made frequent visits back to her original territory and once fought unsuccessfully with the resident female in an attempt to regain her old territory. Because loons can live 20 to 30 years, we will have to wait to learn how losing its territory affects a loon's breeding success in subsequent years.

Just as I have matured, so has the study of loon behavior. We can no longer entertain the engaging notion that loons mate for life, but we can respect loons as tireless parents and paragons of conjugal fidelity. We cannot maintain the myth that loons always treat each other amicably, but we can admire their valiant efforts to defend territories and raise young despite the presence of so many intruders that threaten their status and their chicks' survival. A pleasing, if paradoxical, aspect of my growing knowledge about loon behavior is that as my research has begun to dispel the myths that envelop them, loons are even more fascinating to me now than when I first heard their haunting calls echo across Lake Temagami.

Walter Piper is a research associate in the Molecular Genetics Laboratory and the Department of Zoological Research at the National Zoo. *His work has been supported in part by Friends of the National Zoo.*

Fingering Infidelity

DNA fingerprinting, the same technique that has achieved renown in criminal investigations, has had a great impact on the study of animal mating systems. Ten years ago, techniques for determining parentage were onerous, inefficient, and seldom used. As a consequence, scientists were forced to infer parentage of young animals based solely on behavioral observations. Determining maternity was often straightforward, particularly in mammals, in which females give birth to and then care for young over an extended period. On the other hand, paternity assignment was riddled with problems.

The development of molecular techniques to generate "DNA fingerprints," individual-specific patterns of DNA fragments that are passed from parents to offspring, has made the assignment of paternity and maternity a simple matter in cases where DNA samples are available from a young animal and two putative parents. One of the most striking findings from early DNA fingerprinting studies is the frequent discovery in songbirds of extrapair young, that is, young that are the genetic offspring of a female and a male other than her mate. In cardinals, seven percent of all young result from extrapair matings, while the figure is 28 percent in red-winged blackbirds, 35 percent in indigo buntings, and 50 percent in tree swallows.

Scientists now recognize that while most birds are socially monogamous, pairing with a single member of the opposite sex, far fewer produce offspring with only one mate. It is also clear that the tendency of male songbirds to "shadow" their mates before and during the egg-laying period is an attempt to prevent extrapair matings.

—*Walter Piper*

Life without Light: Discoveries from the Abyss

Robin Meadows

The depths of the sea were once believed to be nearly as devoid of life as the moon. A mile and a half below the ocean's surface, the ambient water was thought to be always cold because no sunlight can penetrate so deep. Those creatures hauled up from these dark reaches were considered scarce and believed to subsist largely on organic material drifting down from above.

Six-foot-long tube worms are among the most plentiful creatures crowding the ocean floor around a deep-sea spring, or hydrothermal vent, near the Galapagos Islands.

Richard A. Lutz

Although this collection of tube worms and white crabs may at first look like a shallow-water scene, these unusual animals were photographed more than 8,000 feet below sea level.

At least that is what many scientists thought until 1977, when two geologists descended 8,200 feet into the ocean near the Galapagos Islands. The geologists were looking for a deep-sea hot spring or hydrothermal vent, which they had predicted to exist along rifts, areas where the sea floor is spreading apart and where volcanic activity and superheated water were likely to occur. Lava wells up through the rifts, forming new crust and heating the water that percolates down through cracks in the crust. Hydrothermal vents then spew this hot water back into the sea (see box, page 18).

As expected, they found the first vent, an area about 100 meters across where 60°F water "streamed out of every orifice and crack in the sea floor," says Massachusetts Institute of Technology geologist John Edmond. But they also made a completely unexpected discovery: The vent was jammed with animals.

"Here we came upon a fabulous scene," says Edmond. "Reefs of mussels and fields of giant clams...along with crabs, anemones, and large pink fish." Both the 10-inch clams and the blind crabs scuttling about were porcelain white, in stark contrast to the otherwise barren black basalt of the newly formed ocean floor surrounding the vent. The other-worldliness of the scene was heightened by the fact that the most common animal was the giant tube worm, a six-foot invertebrate that extends feathery, bright red plumes from the top of its chitinous white tube.

Biologists were astonished. "I got a call...from the chief scientist...who said he had discovered big clams and tube worms, and I simply didn't believe it. He was a geologist after all," said Woods Hole Oceanographic Institution biologist Holger Jannasch to *Time* magazine.

The serendipitous discovery of vent life raised many puzzling questions, perhaps the most perplexing of which was, what

Dudley Foster/Woods Hole Oceanographic Institution

Giant tube worms lack mouths and guts, relying instead on nutrients provided by bacteria living inside them, which eat sulfide the tube worms collect from the surrounding water.

were these animals living on? Most living things get their energy from sunlight. Plants photosynthesize and so depend directly on the sun for their energy, and animals eat plants or plant-eating animals and so depend indirectly on the sun for their energy. But what was the source of energy here in the deep, dark depths of the sea? Figuring out what the giant tube worms (*Riftia pachptila*) lived on was especially mystifying because they had no mouths, guts, or anuses!

This last question was answered in 1980, when then-Harvard graduate student Colleen Cavanaugh had a wild idea that turned out to be right. Answering the question of the vent life's energy source actually turned out to be relatively straightforward. The water spurting from hydrothermal vents is full of hydrogen sulfide and other energy-rich compounds. Before the discovery of the Galapagos vent, it was well known that terrestrial sulfur springs are home to bacteria that get their energy by oxidizing the sulfide in the water. These bacteria thus get their energy by chemosynthesis rather than photosynthesis.

Likewise, hydrothermal vents are teeming with sulfide-oxidizing bacteria. The bacteria grow in thick, white-to-yellow-to-pink mats that cover all the hard surfaces around the vents from rocks to clam shells to tube worm tubes. As abundant as the bacteria are above the vents, however, scientists believe that even more grow in pores below the rocky surface. "Occasionally blooms of...bacteria become so dense they create a whiteout, a patchy bacterial blizzard," says biologist Cindy Lee Van Dover of Duke University.

Many of the animals living at vents eat these sulfide-oxidizing bacteria—the first case of animals that depend on chemosynthesis rather than photosynthesis for their ultimate source of energy. "One of the most significant events in the earth and life sciences in this century was the real-

J. Frederick Grassle/Woods Hole Oceanographic Institution

Raw bar down under: A bed of foot-long clams and large white crabs crowd the ocean floor at the Galapagos vent site.

ization that hydrothermal activity can support life in the absence of sunlight," says Van Dover.

But what of the mouthless, gutless giant tube worms? They obviously weren't eating bacteria. The prevailing hypothesis was that they were absorbing tiny particles of food through their skin. This method of "eating" had originally been proposed for their cousins, hair-sized tube worms that also lack mouths and guts. First found in 1900, these tube worms are so small that they could theoretically absorb all the food they need across their skin. The giant tube worms, however, are so big that they would not be able to get enough nutrients using this method because their surface area relative to their body size is smaller.

This mystery began to unravel when Harvard's Cavanaugh had a flash of insight at a graduate seminar on the giant tube worms. She was watching Meredith Jones, then curator of worms at the Smithsonian Institution, give a slice-by-slice tour of a giant tube worm that had been cut like a salami. When Jones reached a slice of the trophosome, an organ of then-unknown function that dominated the inside of the tube-worm—extending along 75 percent of its length—he mentioned that he had seen sulfur crystals in this organ.

"At this point, I jumped up and said, 'It's perfectly clear that tube worms have symbiotic sulfide-oxidizing bacteria,'" recalls Cavanaugh, explaining that elemental sulfur is the most common intermediate of sulfide-oxidizing bacteria. "[Jones] essentially said, 'Sit down, kid, we think the trophosome is a detoxifying organ.'" The detoxification hypothesis had been proposed because the levels of sulfide and other minerals in vent waters are so high that they would be fatal to most animals.

When asked if other biologists initially thought she was nuts, Cavanaugh, who is

Richard A. Lutz

now on the faculty at Harvard, laughs and responds with a resounding, "Yes!" But the idea made perfect sense to her. Cavanaugh was familiar with sulfide-oxidizing bacteria because before starting graduate school, she had spent two years studying the ecology of a sulfide-rich salt marsh near the Marine Biological Laboratory in Woods Hole, on the coast of Cape Cod.

Her conviction that the giant tube worms had symbiotic bacteria was so strong that she persisted and got a sample of giant tube worm tissue from Jones. With the help of other biologists, Cavanaugh stunned the scientific community by showing that tube worms did indeed harbor bacteria inside their trophosome cells. In fact, bacteria comprise the bulk of trophosome tissue. Other researchers showed that the trophosome contained enzymes characteristic of sulfide-oxidizing bacteria that are not found in animal cells.

Symbiosis is a partnership that can result in two (or more) species essentially functioning as a "new organism" that can thrive in an environment where neither species would flourish alone. In this case, the tube worm gets a source of food in the nutrient-poor depths of the ocean, although it is not yet clear whether the tube worms live on bacterial excretions or dead bacterial cells. And the bacteria get a guaranteed supply of sulfide: A tube worm collects the compound with its red plumes and delivers it to the bacteria via sulfide-binding proteins in its blood.

While this was the first known case of an animal with chemosynthetic bacteria living in its cells, the concept was not as far-fetched as it might sound. Scientists had known for years that many corals and sea urchins have photosynthetic algae living within their cells. And studies also indicate that mitochondria, the energy-producing parts of all plant and animal cells, evolved from free-living bacteria (see box, page 17).

Giant tube worms were the first animals known to host chemosynthetic bacteria. Since this discovery, scientists have tagged more than 100 species that likely share similar symbiotic relationships with bacteria.

J. Frederick Grassle/Woods Hole Oceanographic Institution

A cloak of yellowish bacteria covers tube worms and a clam bed. Sometimes thick blooms create "bacterial blizzards" that drift through the water and blanket parts of the ocean floor.

While going from two separate organisms to a single symbiotic organism seems like a big jump, this transition undoubtedly took place by degrees. First, free-living bacteria probably started living on the tube worms' skin. Next, the bacteria probably began living under the skin and finally within tube worm cells. In support of this theory, Cavanaugh cites living examples of these intermediate steps: nematodes that have bacteria living on them, and oligochaetes (segmented worms) that have sulfide-oxidizing bacteria living under their protective outer layers, or cuticles.

Ironically, although these symbioses were first found at a deep-sea hydrothermal vent, biologists have since found that they exist widely in far more accessible environments. As it happened, Cavanaugh found the next animal with symbiotic bacteria in its cells near Woods Hole, where biologists have been studying marine creatures since the 1800s.

"I'd been thinking about sulfur and bacteria a lot, and I thought 'why not chemosynthetic symbiosis wherever there's sulfur?'" says Cavanaugh. After finishing her tube worm work, she turned her attention to a clam, *Solemya velum*, that lives in sulfide-rich eelgrass beds. Clams in the genus *Solemya* had long been a mystery because their guts are either extremely small or non-existent, and their feeding appendages are too short to reach outside the shell. While *Solemya velum* does have a small gut, Cavanaugh found that this clam could not possibly eat enough to sustain itself.

In light of her discovery of what tube worms live on, she was not at all surprised to find that *Solemya velum* had symbiotic bacteria within the cells of its gills. Subsequent research showed that the 10-inch white clams from the Galapagos vent and most other vent molluscs also have symbiotic bacteria in their gills, which are unusually thick and fleshy.

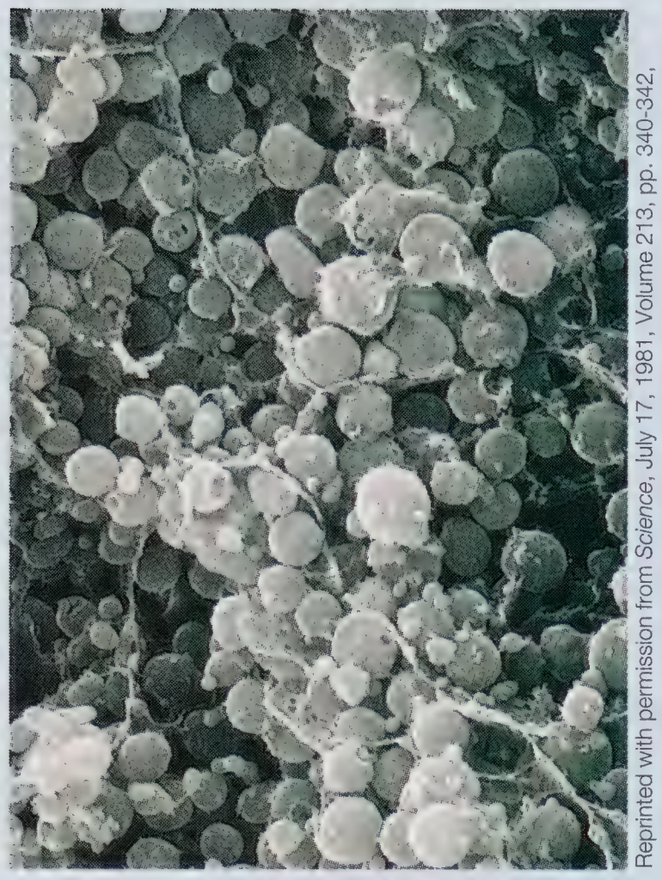
Today biologists believe that such symbioses exist in more than 100 species of marine invertebrates, including the tiny tube worms originally thought to subsist on food absorbed through their skin. All these animals live in sulfide-containing environments from mudflats to sewage outfalls to petroleum-laced sediments.

While most of the known chemosynthetic symbionts depend on sulfide for their energy, many other energy-rich compounds could support symbioses between aquatic animals and bacteria. These compounds include methane, manganese, and ammonia. Recently Cavanaugh and other researchers have determined that several marine invertebrates have symbiotic bacteria that get their energy from methane, which is found in many environments from hydrothermal vents to cold-seeps, cold springs in the Gulf of Mexico and the North Sea.

These species include two mussels from the Gulf of Mexico, a hair-sized tube worm found off the coast of Denmark, and a mussel from a vent along the Mid-Atlantic Ridge. This vent mussel is particularly intriguing because it may also have sulfide-oxidizing bacteria, which would allow the mollusc to take advantage of whichever energy source was more abundant at a given time. "It's unprecedented to maintain a stable symbiosis with two kinds of bacteria," notes Cavanaugh.

The discovery of the hydrothermal vents and the wondrous creatures they sustain shows that despite millennia of study, the world around us still holds surprises. The depths of the sea remain largely unexplored—99 percent of the sea floor has yet to be mapped—and there's bound to be plenty more hot stuff down there.

Robin Meadows is a contributing editor to ZooGoer.



This electron scanning microscope photo shows bacterial cells that live inside giant tube worms.

ALIENS IN OUR CELLS

Symbiosis between animals and intracellular bacteria sounds like the stuff of science fiction—maybe it's okay for worms living at the bottom of the deep sea but it's got nothing to do with us. Or does it? Like all other animals, we have organelles in our cells that biologists believe evolved from free-living bacteria. These organelles, called mitochondria, produce our cells' energy. Plants and fungi also have mitochondria, and the theory is that an ancestral cell common to all three groups formed a symbiotic relationship with bacteria: This ancestral cell gave the bacteria food in the form of the simple sugar glucose while the bacteria provided the cell with energy.

Biologists proposed this theory because even now, after millions of years of evolution, mitochondria have many bacterial characteristics. For example, mitochondria are the only organelles in animal cells that have their own DNA. Furthermore, mitochondria and bacteria are about the same size, reproduce by dividing in two, and use the same chemical pathway to produce energy.

—Robin Meadows

SMOKING IN THE DARK

The deep-sea hot springs known as hydrothermal vents are found along the oceans' ridges, a total of 46,000 miles of submarine mountain ranges that extend north to south through all the major seas. These ridges grow where the massive tectonic plates of the earth's crust are pulling apart. As the plates separate, lava flows in between them, adding new sea floor at up to seven inches per year. The newly formed crust is made of dark, glassy lava that cracks as it cools. Water seeps through these cracks, picking up heat and minerals from the molten rock that lies beneath the crust. This water then spouts back out through the vents.

The water ranges from 50 to 700˚F, depending on the type of vent. Even at temperatures above 212˚F, however, the water is superheated rather than boiling because the pressure is so great (250 atmospheres) at the depths where vents have been found—from 2,600 to 20,000 feet (the deepest the sea gets is about 35,000 feet). While the temperature of the hotter vents' water is far too high for animals to live in, this superheated water mixes so rapidly with the near-freezing surrounding water that most vent animals live at temperatures close to 35 ˚F.

Vents are home to a great diversity of life: more than 250 known species of free-living bacteria and about 300 newly described animal species. These animals typically live within about 30 yards of their vent.

Not surprisingly, vents in different parts of the world tend to have different animals. For example, the giant tube worms live only along the East Pacific Rise, which lies off the western coasts of Mexico and South America. Shrimp predominate at vents along the Mid-Atlantic Ridge, and barnacles, limpets, and snails predominate at the Mariana vents of the western Pacific.

—Robin Meadows

A black smoker spews superheated water into the cold depths on the East Pacific Rise. These underwater chimneys seem to be emitting smoke, which is actually the swirling of countless particles that are separating as metal-enriched water is forced at high speed into colder surroundings.

A Peek at Peccaries

Jeffrey P. Cohn

Jerry Day walks along a Sonoran Desert ridge in Saguaro National Park near Tucson. It is an early spring morning, and the desert sun has not yet sent most animals into shade or cool burrows, or most people into anywhere with air-conditioning.

Day scans the desert landscape, hoping to spot a javelina herd not yet bedded down for the day. He sees none, but points out a nearby mesquite thicket. Tough prickly pear, sharp hedgehog, and tiny pincushion cacti, spindly ocotillo, and flowering brittlebush surround a lone mesquite tree. "This is ideal javelina habitat," says Day, a retired Arizona Game and Fish Department wildlife biologist, of the mixed scrub and cactus habitat. But, he adds, "There were no javelinas in Arizona 300 years ago, while they're all over now." In fact, in some parts of southern Arizona, New Mexico, and Texas, javelinas are now, after deer, the most abundant large herbivores. Javelinas also have one of the widest distributions of any American ungulate, ranging from northern Argentina and Uruguay through Central America, Mexico, and now the southwestern United States.

What is it about javelinas that draws Day and other wildlife biologists to admire and study what any honest observer must admit is not the handsomest of animals? Day isn't sure, but they proved irresistible to a young boy growing up in New Jersey. "They were the first animals I wanted to see when I got to Arizona," Day says. "I could just sit for hours and watch them. They are just so darn fascinating."

The javelina, or collared peccary (*Pecari tajacu*), is one of three species of peccary, all of which are native to the Americas. The others are the white-lipped peccary (*Tayassu pecari*) and the Chacoan peccary (*Catagonus wagneri*). Superficially, all three New World peccaries look and act much like suids—Old World pigs and hogs—to which they are only distantly related, having shared a common ancestor some 40 million years ago.

Like pigs, peccaries have large heads that end in tough, disk-shaped snouts ideal for rooting in the ground for food. Both pigs and peccaries have long bristly hair, protruding canine teeth, and

Jerry Day

Although they look fierce, with their flashing tusks and bristly coats, javelinas prefer to flee at the first sign of a dangerous predator.

Jerry Day

Jerry Day

(Top) A group of somber-hued peccaries become part of the Arizona scrub as they quietly forage.

Spanish explorers called javelina "musk hogs" for the pungent odor released from their conspicuous scent glands. Although they seem pig-like in appearance, they are only distant relatives.

a tendency to grunt a lot. But a closer look reveals significant differences between the two groups.

Most obvious is that peccaries have conspicuous scent glands on their backs, just in front of their short tails. It's not surprising that early Spanish explorers called the javelinas "musk hogs," for the gland and its pungent aroma. Peccaries also have multi-chambered stomachs reminiscent of cattle and other ruminants. In contrast, pigs' stomachs are simple with no chambers. On the other hand, pigs have gall bladders, but peccaries do not. Finally, peccaries have 38 teeth while most pig species have 44, and peccary canine teeth are relatively short, straight, and interlocking compared to the long, sometimes elaborately curved ones of pigs. The javelina's name derives from the Spanish word "jabalina," a reference to these spear-like canines.

Of the three species of peccary, the javelina is the most adaptable, occupying habitats from desert scrub and chaparral to dry woodlands and dense rainforests, and from low valleys and canyons to mountains up to 8,000 feet in elevation. White-lipped peccaries are found mostly in humid tropical forests from southernmost Mexico to northern Argentina, but also appear in dryer areas. Most specialized in habitat is the Chacoan peccary, which lives only in the Gran Chaco, a desert and dry scrub forest region of Paraguay, northern Argentina, and southeastern Bolivia. White-lipped peccaries and javelinas overlap in parts of their range, while all three species occur in the Gran Chaco.

Smallest of the peccaries, javelinas stand about 18 inches tall and weigh up to 55 pounds. White-lipped peccaries are larger, reaching 85 pounds. Chacoan peccaries, which have unusually large skulls, are the giants, standing up to 27 inches tall and weighing close to 100 pounds.

Amazingly, until about 20 years ago, the Chacoan peccary was known to Western science only as a fossil. The species was believed to have been extinct by the end of the Pleistocene era, about 12,000 years ago. Then, in 1975, it was "discovered" in the inaccessible thorn forests of the Gran Chaco. Local people, of course, were well aware of the species, it being commonly hunted for food. The Chacoan peccary remains the only peccary on the endangered species list. Javelinas, on the other hand, are well known, although they have been studied most intensively in Arizona, at the northernmost limits of their range.

The Chacoan peccary is a highly specialized cactus eater, says Andrew Taber, a wildlife biologist and Bolivia program officer for the Wildlife Conservation Society. At least 75 percent of its diet consists of the pads, fruits, and flowers of prickly pear and other cacti. Like all cacti and many other desert plants, prickly pears are succulents. They absorb huge amounts of water after rains, then store it for dry times ahead. The prickly pear pads, or cladophylls, as the branches that look like leaves are called, may be 80 percent water at their peak.

Javelinas in the southwestern U.S. also depend on prickly pear, not only for water obtained from the pads but also for nourishment from the reddish-purple fruit and yellow flowers. Indeed, at Big Bend National Park in Texas, prickly pear totals two-thirds of the javelinas' diet, says John Bissonette, leader of the Cooperative Fish and Wildlife Research Unit at Utah State University.

"The northern extension of the javelina's range in Texas seems tied to the contiguous prickly pear growth," Bisonette says. "They eat a lot of prickly pear, but it's not their preferred food. It's a maintenance food they can fall back on during dry times."

To eat a spine-covered prickly pear pad, a javelina sometimes knocks it to the ground, says Robert Lochmiller, a zoologist at Oklahoma State University. Then, holding the pad with a foot, the javelina pushes it with its snout to break off the long, sharp spines before eating the watery pulp inside. But just as often, the animals simply break off part of the pad and eat it spines and all. "It makes studying their droppings hard," Day says.

In addition to prickly pear, javelinas forage for acorns and other nuts, fruits, mesquite, other beans, roots, and bulbs, as well as grasses and forbs. During winter, javelinas will raid pack rat dens in search of stored seeds. They even occasionally eat insects and other invertebrates as well as carrion. And, in their search for food, javelinas may even become pests. In Arizona, they often stroll into outlying areas of cities looking for food. "They'll clean out any garden," warns Tice Supplee, chief of the Arizona Game and Fish Department's game branch. "They love to root for tulip bulbs."

It was actually human activities that gave javelinas the opportunity to expand their range into the southwest U.S. over the last few hundred years. European settlers' cattle overgrazed the southwest's dry grasslands, Supplee says. As a result of overgrazing, prickly pear, mesquite, palo verde, and cholla cactus replaced the native grasses, creating the scrub habitats that javelinas prefer in southern Arizona, New Mexico, and Texas.

Cold weather, however, may inhibit more northerly expansion of the javelina's range. Being basically tropical animals, they lack insulating underfur or the ability to lay down the layers of fat that keep temperate zone mammals warm in winter. Still, Supplee says, javelinas have adapted to some colder regions around cities in northern Arizona by seeking shelter in road culverts, under mobile homes, or near buildings. They may also retreat into caves or abandoned mine tunnels to escape chilling winters. And herd members often huddle together for warmth during cold nights. Youngsters even clamber over adults to squeeze between the larger animals.

Javelinas exhibit few of the physiological adaptations that many desert animals possess. They cannot reduce the water in their urine and feces like some desert rodents, for example, says Stamatis Zervanos, a biologist at Pennsylvania State University's Berks campus in Reading.

But javelinas do undergo an annual molt, Day says. Normally mostly black-haired with speckles of gray and white underneath, the black tips of the long bristles break off as temperatures start to rise in Arizona after the winter rains. By summer, the animals appear more gray or even white in spots. Light colors reflect heat better than dark ones. The black-tipped bristles regrow in the fall.

Daily activity patterns also change with the seasons. In summer, javelinas forage in the evening, at night, and very early in the morning. Then, as morning temperatures in Arizona rise into the 80s on their way to 90 or 100 or above, Day says, javelinas head to one of the several bed sites within their territory. Such sleeping

Jerry Day

Jerry Day

(Top) The daily activities of a javelina herd vary by season, but the group usually beds down in shady thickets or under rock overhangs during the hottest weather.

In the Southwest, prickly pear cactus provides peccaries with water and nourishment, which they acquire from eating both the plant's flowers and fleshy pads.

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Daniel M. Brooks

(Top) Large herds of white-lipped peccaries wander through the tropical forests of Central and South America in search of palm and other nuts.

The elusive Chacoan peccary was known to Western science only as a fossil until scientists "discovered" the first living individuals in 1975.

areas are usually in the shade of a dense thicket, under a ridge or wash overhang, or in a cave. By 9 a.m., they are usually bedded down, not to rise again until late afternoon or evening. As daytime temperatures start to drop in the fall, active periods stretch later into the morning and begin again earlier in the afternoon. By the onset of winter, activity patterns are reversed from those of the summer.

Javelinas may also move up mountains to feed in Arizona's cooler juniper and pine forests at the higher elevations in the spring and summer, Day says, then descend back into the lower oak woodlands and chaparral in fall and winter.

Water is also a concern. During long dry spells, javelinas can get the water they need from prickly pear pads. But in some places, javelinas take advantage of water tanks built for cattle or deer and bighorn sheep. And in the Three Bar Wildlife Area, a U.S. Forest Service preserve near Phoenix, each javelina territory has at least one natural or man-made source of water, says John Byers, professor of zoology at the University of Idaho.

All species of peccaries form herds. These herds typically include equal numbers of adult males and females, with no obvious leaders, plus their offspring. While javelina herds in Arizona usually number 10 to 15 and Chacoan peccaries three to five, white-lipped peccary herds usually total 50 to 150 animals and occasionally reach 400.

Herds as large as those of white-lipped peccaries are unusual in forest-living species, where solitary individuals or small family groups are the rule. What's different about white-lipped peccaries? Richard Kiltie, a University of Florida zoologist, thinks the answer lies in predator defense. White-lipped peccaries eat palm and other tough nuts, making loud sounds as they crack them open. The sound may attract predators such as jaguars and mountain lions. The larger the herd, Kiltie says, the more likely an individual will detect danger in time to warn the others. In what biologists call a "runaway process," white-lipped peccary herds grow larger until the food available in the herd's home range can no longer support all the herd members, thus negating the defensive advantage of still larger group size. Perhaps because they are smaller and eat softer nuts and fruits, javelinas have less need for large herds, Kiltie says.

Although smaller, javelina herds are very stable. Few animals enter or leave a herd except through birth or death. Byers thinks javelinas' highly social and cooperative behavior encourages individuals to stay within their herd. He especially thinks young javelinas learn to stay within their herd through the solicitous behavior shown by adults toward juveniles. Adults share food with youngsters and tolerate their play. Lactating females also let any young born in the herd nurse from them.

Herd stability is reinforced by scent marking. The scent glands on javelinas' backs produce an odoriferous and oily fluid that they use to mark each other as well as objects in their territory. The scent helps javelinas to identify herdmates and to find each other if scattered.

Javelinas are said to show extreme altruism when faced with danger. Reports talk of lone javelinas facing a bear, mountain lion, or other large predator, sacrificing themselves while other

herd members escape. Not necessarily so, says Byers. Javelinas are very shy beasts, he notes, that will bolt and run if they detect people or other dangerous animals nearby. With notoriously bad eyesight, they depend on a keen sense of smell to detect predators.

How javelinas respond to danger depends on the source and how soon they detect it, Byers says. If they smell a predator in the distance, javelinas come together, quickly scent mark one another, then head off single file to safety. If the predator gets close before it is detected, however, javelinas scatter in all directions, reuniting later when the danger has passed. Only if a large predator is close enough to catch a javelina will it turn in desperation to face its attacker.

If a smaller predator approaches, one or two adults move aggressively toward it while the others quickly depart. Byers reports seeing javelinas force bobcats to scamper up saguaros, send coyotes running, and even kill domestic dogs. Other times, however, bobcats and coyotes do manage to kill young javelinas.

It is the herd behavior of javelinas that makes them fascinating to some biologists. Supplee says, "They are the most social and care-giving animals I've had the opportunity to study." But in the end, it is their looks that attract others. Perhaps it is because they are "the ugliest animals in the world," says Bissonette, quickly adding: "But they have a fundamental beauty about them."

Jeffrey P. Cohn is a Washington, D.C.-based freelance writer.

Jessie Cohen/NZP

Digging the Zoo

Along one side of the National Zoo's Small Mammal House, you can find a small slice of the Southwest wallowing here in Washington. Three javelinas (or collared peccaries)—one eight-year-old male and two four-year-old sibling females—call the Zoo home. On exhibit with them grow cacti, evocative of the arid southwestern U.S., where javelinas today can be found. Peccaries feed on cacti in the wild, yet the Zoo's javelinas so far have left the prickly plants alone. Instead, they pig out on alfalfa hay, carrots, special "pig grower" pellets, and the occasional treat of an apple or other fruit or vegetable delicacy.

A depression in the ground of the Zoo's javelina exhibit creates a natural pool when filled with rainwater, where these peccaries can wallow away sunny summer days. If it gets too cold, or too hot, they may take refuge inside a small enclosure, but nicer weather brings them scurrying outside. Their outdoor exhibit has been designed to allow the javelinas to root around in the dirt, as they do in the wild when foraging for underground tubers. Keepers have had to add sand and gravel to fulfill the javelinas' digging desires. While wallowing in mud and playing in the sand may make for a mellow mammal, javelinas can potentially be aggressive, and dangerous considering their long, sharp canines. For this reason, keepers at the Zoo do not go into the exhibit with them.

The Zoo's javelinas live here amid plantings of black willow, Indian tobacco, arrowhead, and pokeweed, and beneath a large beech tree. These plants, part of the American Indian Heritage Garden, exemplify native Americans' discoveries of innovative uses for the surrounding flora and fauna. The peccary too has been a part of certain American Indians' heritage and diet. Despite being easily spooked and quite aggressive when threatened, the three species of peccary have been hunted by native American groups from Argentina to Arizona. However, having migrated north from Mexico only within the last 300 years, the javelina is relatively recent quarry for the inhabitants of the southwestern U.S. As a testament to this fact, no separate word for javelina exists in the languages of the Pima and Tohono O'odham Indians of southern Arizona.

—Alex Hawes

AT THE ZOO

SAVING THE SKITTISH ELD'S DEER

The term endangered has become a much-used part of our vocabulary. But while most of us readily cite tigers, gorillas, and pandas as examples of endangered species, many other species are consistently overlooked—perhaps because they lack the romantic associations that people have with better-known mammals. Most Americans would probably not mention deer when discussing endangered species. After all, white-tailed deer are so abundant in many places that we consider them a nuisance.

Jessie Cohen/NZP

The CRC's easily spooked Eld's deer are trained to follow routines and tolerate noises that might otherwise send them into a panic.

However, many of the world's 40 deer species are listed as endangered by the World Conservation Union (IUCN).

All three subspecies of the Eld's deer (*Cervus eldi*) fall into this category. Now found only in forested pockets of northeast India, Myanmar (formerly Burma), Cambodia, Laos, Thailand, Vietnam, and the Chinese island of Hainan, they were once far more widespread and common in these areas. Eld's deer have reddish brown coats, and are about the size of white-tailed deer, but their antlers are remarkably different. Occurring seasonally on males, the antlers sweep from front to back in one continuous curve.

About 50 members of the Eld's deer subspecies found in Myanmar live at the Zoo's 3,150-acre Conservation and Research Center (CRC) in Front Royal, Virginia. The first three Eld's deer arrived at the center in 1976, and the animals have proved to be a challenge ever since. Eld's deer are extremely excitable and will run about erratically, bumping into any obstacles in their path at the least disturbance. Scientists at CRC initially believed that the best approach to managing Eld's deer was to allow them to remain in herds in large pastures on the Center's grounds. But monitoring and caring for deer using this type of system was difficult, and the deer would frequently injure themselves during routine, essential procedures.

Associate Director for Conservation Chris Wemmer began to develop new husbandry techniques for managing the Eld's deer. He explored aspects of nutrition and mother-fawn interactions, and then initiated a program to hand-rear some of the fawns. These animals could be more carefully monitored, but they continued to react badly to disturbances.

Biotechnician Linwood Williamson believed that the best way to reduce the deers' self-destructive response to disturbances was to acclimate them to as many different sights and sounds as possible. He began to carry a noisy key ring with him at all times and, over time, made sure the animals saw and heard lawn mowers, tractors, and cars. Eventually even a radio playing in the barn 24 hours a day wouldn't bother the deer.

Williamson now trains the deer at CRC to enter the first open door they reach. Following his encouraging voice, they calmly walk onto a scale for routine weighing, enter their individual stalls, and even board a trailer. This allows researchers to work with the deer in ways that would not otherwise be possible. Veterinarians, for instance, can now routinely vaccinate and draw blood from the animals without having to use an anesthetic.

The ability to work so closely with the deer at CRC has provided a unique opportunity to study their reproductive biology. Research Veterinarian Steve Monfort established the Endocrine Research Lab at CRC in 1987, and since then has been studying the Eld's deer's reproductive physiology. First he characterized the re-

Two Eld's deer stags peer through the mist at CRC.

Lisa H. Ware/ORC

productive cycles of males and females by monitoring their hormone levels throughout the year. Monfort did this by analyzing hormone levels in the animals' urine, which Williamson easily collected by leading the deer into a specially designed stall that collected samples when the animals would urinate.

CRC biologists applied the information gained from these studies to an assisted-reproduction program. Monfort established that female deer begin estrus in late winter or early spring and that they enter anestrus, a period during which they are not sexually receptive, during the autumn months. Studies on males showed that they are essentially infertile from June to September. With this information, researchers could plan the best times for breeding animals and for collecting sperm from males for artificial insemination.

Due to the problems of shipping Eld's deer between institutions, it has previously been difficult to pair animals that are the least related. With the intensive management strategy and knowledge about reproductive biology developed at CRC by 1992, CRC biologists were ready to address this concern. They determined which animals within the U.S. population possessed the most valuable (under-represented) genetic information. The artificial insemination technique allowed suitable pairings to be arranged without transporting any animals.

The artificial insemination trial at CRC was highly successful, producing the largest number of pregnancies of an endangered species by artificial insemination. Seven of the 20 females artificially inseminated became pregnant. The seven surviving youngsters, considered a genetically sound population, were successfully shipped to the Singapore Zoo to begin a new breeding program there. Another effort in January 1995 resulted in five pregnancies from 18 attempts.

Meanwhile, CRC researchers are working with the Wildlife Sanctuaries Division of the Myanmar Forestry Ministry to improve wildlife protection measures and develop and implement a conservation program that includes a project for Eld's deer. Most of the Eld's deer found in Myanmar live in the Chatthin and Shwesettaw wildlife sanctuaries. Unfortunately, lack of funding and warden training in Myanmar's reserves mean that the staff there are ill-equipped to handle poaching and habitat encroachment. For example, when Bill McShea, a wildlife biologist at CRC, traveled to the Chatthin sanctuary in January 1995, he found that the staff there didn't even have vehicles to use for patrolling the sanctuary.

The CRC group has now established two teams of foresters and rangers to conduct ongoing field studies in the Chatthin sanctuary. In addition to gathering crucial information on the reserve's wildlife and habitat, CRC researchers aim to provide the Myanmar Forestry Ministry with training that will enable them to successfully manage Eld's deer in the wild.

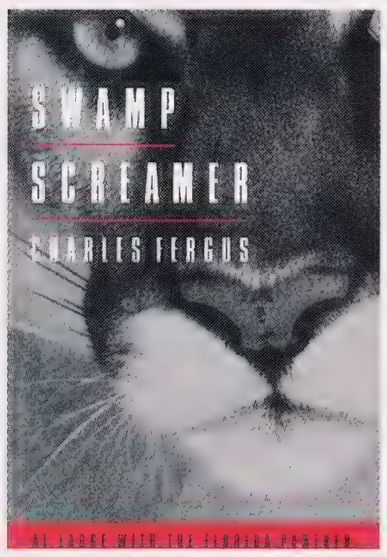
Initial population censuses suggest that only about 2,000 Eld's deer remain in Myanmar—a 40-percent decline in the last 10 years. An ever-increasing human population on the periphery of the sanctuary brings more and more people in to collect fuelwood, thatch, and fruits. Those involved in the program recognize the urgency of stemming the decline of Eld's deer, but they also understand the need to balance this interest with those of the people living in communities surrounding the Chatthin sanctuary. They hope to accomplish this by encouraging local participation in the project and by providing environmental outreach programs.

In the meantime, studies of Eld's deer at CRC continue. Monfort hopes to begin in vitro fertilization trials this year. This technique of developing an embryo outside of the womb has far-reaching implications. The population of the Indian subspecies of Eld's deer has dwindled to less than 200, and biologists at CRC think that they could rapidly increase this number by implanting embryos from this subspecies into Zoo females of the subspecies found in Myanmar.

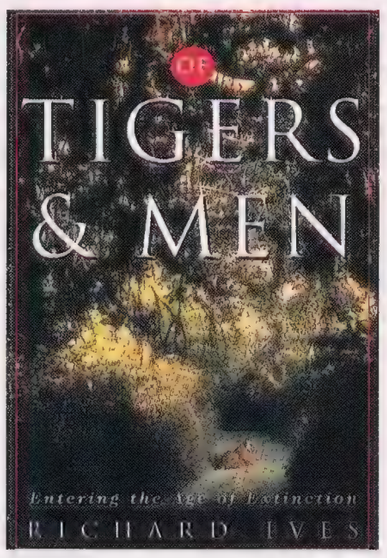
Despite being a reproductive biologist, Monfort is quick to say that technology alone will not save an endangered species. He recognizes that efforts aimed at improving the status of Eld's deer in the wild must combine lab research with the husbandry and field studies that have been carried out with the endangered CRC deer. Eld's deer are not an attention-grabbing species, but they uniquely contribute to the world's biological diversity—a diversity that researchers at CRC strive to preserve.

—Kasey McCracken

books, naturally



Swamp Screamer. 1996. Charles Fergus. North Point Press, Farrar, Straus and Giroux, New York. 209 pp. hardbound, $23.00.



Tigers & Men. 1996. Richard Ives. Nan A. Talese, Doubleday, New York. 304 pp. hardbound, $24.95.

To seek, experience, and describe face-to-face encounters with a great carnivore on its own turf is an enduring theme in natural history writing. "I see the tigress. Her face is half concealed behind a small shrubby tree. Before I can move, before I can speak, I know that she is running, the orange of her coat streaking through the shadows, coming straight at us...." writes Richard Ives in *Of Tigers & Men* of his quest to experience wild tigers and to learn from the men and women who have made watching wild tigers central to their life work.

Charles Fergus sought out Florida panthers and the Florida panther "people" and reports on his encounters in *Swamp Screamer*. "Yowwwwwl! The cry was sharp and descending....Had I not known there were two such creatures [Florida panthers] close by, the sound might have terrified me. As it was, I wondered if I should feel terrified. [Deborah] Jansen obviously did not; she was grinning." This experiencable aspect of ecology is the lyric core of the nature essay according to the editor and poet Edward Lueders but these books have taken this writing form into a new genre: the extinction book.

Because tigers and Florida panthers are endangered—pushed to the final edge of their existence in the wild—the experience of seeking and encountering them takes on great urgency and intensity. Might this be the last such encounter ever to be reported? In seeking these encounters, both authors experience and report on the environmental factors—mostly human related—that created the conditions leading to the endangered status of these powerful predators today. Endangered means that if present trends continue, extinction in the wild is inevitable in the near future. Humans created these conditions; only humans can reverse them. In their own ways, both Ives and Fergus are overcome with the reality and finality of the extinction of such great creatures and react with varying amounts of shock, anger, sorrow, even some grieving.

Fergus previously has written elegantly about the natural history of rural Pennsylvania. In *Swamp Screamer* he journeyed to southern Florida. As the story unfolds, the continued existence of a small population of Florida panthers (a subspecies of the puma, *Puma concolor*) is confirmed. The conservation of this population of fewer than 50 individuals was embraced by agencies newly charged and empowered by the Endangered Species Act. The very process of studying the panther and establishing that its conservation could not be achieved by simply relying on south Florida's large national park and state and federally owned system of wildlife refuges evoked strong and contrasting reaction by different interest groups.

Land owners within panther habitat feared what a designation as critical Florida panther habitat would mean to their property values and livelihoods. Deer hunters were nervous they might

face reduced seasons, restricted hunting areas, and reductions in numbers of deer for their taking if a greater portion of the south Florida deer herd was designated as Florida panther food. Florida wildlife and natural resource management agencies were fearful of alienating a powerful constituency, the deer hunters, and their political bosses who are closely tied to both the hunters and land owners. Florida's growing and increasingly politically powerful environmental groups engaged the debate on the side of the panther. Science weighed in by providing increasingly exact information on sources of mortality, reproduction problems, and ecological needs of the panther. Technology brought into question the exact taxonomic status of the present populations of Florida panthers. (Some panthers were carrying genetic material from central American pumas that had been released in the 1950s). Lawyers at the Department of the Interior scrambled to reassess the department's policy regarding designation of subspecies and application of the Endangered Species Act. Emotions ran high in this environment, and Fergus catches every emotional peak.

The preservation of the Florida panther is proving to be a long-term and costly enterprise, but the population seems to be about holding its own. Well-written accounts such as *Swamp Screamer* are an integral part of this enterprise, because Fergus steps back from the fray, takes a larger look around, and provides this broad view to the larger community that believes that the conservation of endangered species is an important element in their own quality of life. Or, as Fergus puts it: "The panther deserves to live: if not for its sake alone, then for ours. The panther belongs in Florida. The panther is Florida. In a manner of speaking, the panther is all there is left of Florida."

In *Tigers & Men*, Ives, an American leading tours to natural areas in India and throughout the tiger's range in Asia, presents his dialogs with tiger people and his experiences in tiger places in the late 1980s. His is a very gloomy account of the chances of wild tigers or wild Asia remaining a part of the future, although I was impressed with Ives' uncanny good luck in finding and observing wild tigers in India and even in Sumatra's rainforest. He relates his story through the words of various informants and for the most part they are a rather restricted, pessimistic lot. Outstanding tiger conservationist Valmark Thapar, who does not live rooted in the old ways at the crumbling edge of the Raj, is an exception in this regard. I believe a more balanced and hopeful story would have emerged if Ives had broadened his informant base. Moreover, Ives gives scant attention to either new or ongoing efforts to save tigers.

The survival in the wild of powerful predators that are metaphysical symbols for many people hinges upon the capability and will of humankind. But ways and means to reverse their downward spiral and fend off their extinction, are beyond the reach of a single individual or even a group that has taken up the challenge or been given this responsibility by law. Solutions to the problems posed by these large, endangered carnivores must be taken up by whole societies. In *Tigers & Men*, Ives expresses great anger at the failure of governments in the tiger's ranges to save tigers. In contrast, in *Swamp Screamer*, Fergus depicts democratic government, federal and local, and the people it serves working together to find solutions to the panthers' dilemma.

These books begin as great adventure stories and as very good nature writing. In the end, they evoke great unease and tension in the reader, as good descriptions of the extinction process should.

—John Seidensticker
Curator of Mammals

notes & news

DRAGONFLIES WELCOMED

A small pond just across Olmsted Walk from the Visitor Center was dug and planted this spring. Its aim: to attract dragonflies. The pond is ringed with reedy plants and snags that should attract displaying male dragonflies, while beneath the water's surface, submerged plants provide shelter for eggs. Of the 450 dragonfly species in North America, about 60 occur in the Washington area. Green darners are among the species that might frequent the new pond. Many people unjustifiably fear dragonflies, which are harmless to us. Dragonflies, however, are the nemesis of many nuisance insects, such as midges and mosquitos, and many people welcome them in the warm months.

Jessie Cohen/NZP

SUMMER NIGHTS AT THE ZOO

On Wednesday, June 5, Stephen Buchmann and Gary Paul Nabhan, authors of *The Forgotten Pollinators*, will explore the often over-looked, but vitally important link between plants and animals during a book-signing and lecture at the Visitor Center. The authors will examine the roles animal pollinators play in preserving biodiversity and in bringing food to our tables. The book-signing will start at 7 p.m., and the lecture will follow at 8 p.m. Admission is free, but please reserve your space by calling 202.673.4801, or e-mail to nzpem053@sivm.si.edu

Many FONZ members consider **Zoo Night** their favorite summer event, and this year once again the Zoo will close its doors to the public for two member-exclusive nights: June 14, for those with last names beginning with A through L, and June 28, for members with last names starting with M through Z. Call 202.673.4717 if you need more information.

If lounging at the Zoo and listening to soothing live music sounds like a good combination to you, check out **Sunset Serenades** this summer. Thursday nights from June 20 through August 1 (except July 4), Lion/Tiger Hill will be the site for these free concerts. The series starts off on June 20, with the Capitol Woodwind Quintet, which features members of the National Symphony Orchestra. Sunset Serenades start at 6:30 p.m. and run to 8 p.m., and will be canceled by rain only if showers occur at the beginning of, or during, the show. For the first concert, on June 20, there will be a pre-concert session from 5:30 to 6:15 p.m., when visitors can handle musical instruments. During Sunset Serenades, concert-goers can purchase snacks and drinks at the Mane Restaurant. Also, boxed picnic dinners can be ordered by calling 202.673.4978 at least 24 hours before a concert.

RHINOS LEAVING TOWN

The Zoo's two female greater one-horned Asian rhinos, Mechi and Kali, are pregnant, and are due to give birth within two weeks of each other in September. The father, Sport, will move to the Philadelphia Zoo.

Mechi and Kali arrived at the Zoo from Nepal in 1987, and have been companions ever since. After weaning their young, they will move to another facility, but the young rhinos will remain at the Zoo.

The Area Scene

With the arrival of summer, amphibians make their presence known in ponds, lakes, and marshes, while reptiles appear on rocks, logs, and even fence posts. Frogs and toads are among the most noticeable night creatures, and the evening is a likely time to hear groups of male gray tree frogs (*Hyla versicolor* and *Hyla chrysoscelis*) trilling to attract females in trees near standing water. Five-lined skinks (*Eumeces fasciatus*) and northern fence lizards (*Sceloporus undulatus*) can be seen around logs in sunny spots in forests. Be careful if you try to catch these lizards—they may leave you holding only a wiggling tail, which can be easily lost and regrown as a defense against predators.

The Good News...

Fifty years ago, Mexican black bears (*Ursus americanus eremicus*) disappeared from their southwestern U.S. range following relentless hunting and trapping campaigns. Today, up to 20 of the rebounding bruins live within Big Bend National Park in western Texas, having returned and settled down on their own. The first bears appeared and began breeding in the late 1980s, after Mexico banned bear hunting, and the animals had a few exceptional breeding seasons. But the bears' reappearance in the park and other parts of west Texas hasn't thrilled everyone. One rancher, for instance, is demanding compensation for goats and a sheep that were killed this past fall by a female and her cubs. In a debate similar to that which rages over wolves, ranchers, wildlife officials, and biologists have begun discussing how best to protect the interests of both bears and people.

—Audubon, *May/June 1995* and Oryx, *October 1995*

...The Bad News

An escalation in poaching and habitat destruction has led some experts to predict that India could lose all of its wild tigers within ten years. Tiger Link, a newly formed association of environmental groups that is urging the Indian government to act on tiger conservation, estimates that at least one tiger is killed each day to satisfy the strong demand for tiger bone and skin. Estimates of India's tiger population have dropped from 4,334 in 1989 to 3,750 in 1993, although the survey of paw prints used in these counts has been criticized as inaccurate, and perhaps generous. Meanwhile, dozens of seizures of illegal tiger products occur each year in India (67 in 1995 alone), although no one has been convicted recently.

—BBC Wildlife, *December 1995*, and Oryx, *October 1995*

...What's in a Name

Watching a praying mantis at rest, with its front legs folded and prothorax (front part of the body) elevated, it is easy to understand why Linnaeus gave this Old World species of mantid (accidentally introduced to the U.S. in 1889) the scientific name *Mantis religiosa*. The genus name, *Mantis*, means "diviner" or "prophet" in Greek. In rural parts of the U.S., the praying mantis has been known as the "devil's rearhorse" and "mule killer," names that probably arose from superstitions that the mantis' brown saliva could cause blindness in a man or kill a horse or mule. Other cultures have had similar ideas about the mantis' apparent piety. Some Middle Eastern Muslims, for example, believe that it takes its reverent pose facing Mecca. While the name "praying mantis" seems aptly to describe the pious position of the insect, a closer look may suggest that "preying" mantis is more appropriate—its seemingly peacefully folded hands are in fact forelegs modified into claspers used to attack prey.

Urban Animal Safari

The Washington metropolitan area provides ideal habitat for a variety of wild artistic creations. These lively, if inanimate, creatures range all over the region, from our most famous public places to the most secluded private lairs. Pictured here is one of these fantastic animals. Can you track its location? (Look for the answer in the July/August issue.) *Answer to the January/February Urban Animal Safari:* You can find the backlit metal lizard at Bethesda's Cottonwood Cafe.

—*Compiled by Kasey McCracken and Howard Youth*

Christy Bowe

REFRESH YOUR SENSES.

Friends of the National Zoo
National Zoological Park
Washington, D.C. 20008

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